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upon by dilute sulphuric acid, and then washed free from acid and left in water, continued to evolve pure hydrogen for the space of two months, at the ordinary temperature of the air; in considerable quantities, at the temperature of 60° or 70° Fahr.; and in lesser quantity, but without interruption, at 32°. Professor Cooke conjectured that this was owing to the zinc being thrown from the passive to an active state by the action of the acid and of the antimony; but Dr. W. F. Channing attributed it to the galvanic action developed by the acid, in partly detaching the crystals or particles of the antimony from the zinc, so as to form galvanic circuits.

Three hundred and ninety-sixth meeting.

March 14, 1854. — SEMI-MONTHLY MEETING.

The PRESIDENT in the chair.

The Academy met at the house of George B. Emerson, Esq.

The Corresponding Secretary laid before the Academy a letter from Professor Peters, of Königsberg, acknowledging his election as Foreign Honorary Member of the Academy; a letter from the Museum of Practical Geology, London, acknowledging the reception of the New Series of the Academy's Memoirs to Vol. V. Part I., and Vols. I. and II. of the Proceedings; letters from the Royal Institution, the British Museum, the Linnæan Society, the Society of Antiquaries, and Chevalier Bunsen, acknowledging the reception of Vol. V. Part. I. of the Academy's Memoirs, and pp. 233 to 359 of Vol. II. of the Proceedings; and a letter from the Academy of Natural Sciences, Philadelphia, acknowledging the reception of Vol. V. Part I. of the Academy's Memoirs.

Professor Treadwell made a communication "On the Measure of Force." In the Newtonian theory, the measure of force is the mass multiplied by the velocity, or as the momentum; according to the theory of Leibnitz and his followers, it is the mass multiplied by the square of the velocity. The philosophers who have maintained the first theory are chiefly English; those who favor the latter theory are chiefly Continental. The object of the communication was to render intelligible, by a simple illustration, the truth of the second theory.

Dr. A. A. Hayes exhibited and described a modification of the Photometer invented by Ritchie, by which the illuminating power of two flames can be directly compared.

He alluded to the different methods by which the attainment of an accurate measurement had been sought for, by intercepting light and comparing shadows, and pointed out the objections to them; concluding by expressing his opinion that Bunsen's mode, in its adaptation by Mr. King, with the improvements of Mr. Lewis Thompson, gives the nearest approximation to correctness which has been attained.

The instrument exhibited, in the arrangement of the two mirrors and admission of light from the two flames, was essentially Ritchie's. But the modification which renders it a more accurate indicator, and more generally useful, consists in reversing the position of the mirror-plates, and removing the oiled paper, so that the two beams of reflected light are projected downward in a small darkened chamber upon a printed page. Two rectangles of light, side by side, are thus made to illuminate a page, the printed lines on which pass across the chamber and have the same words occurring within the lighted space from each flame. The page is viewed through a partly opened leaf in front, and being at a convenient distance from the eye, a slight inequality in the light on either side is readily seen.

In making the experimental comparisons, the centre of one mirror in the instrument was placed at one hundred and twenty inches from a gas flame by moving the light pedestal supporting it, and on which it slides. A spermaceti candle burning

128 grains per hour, contained in a spring stand, was placed in line on an adjusting support. Motion of either the instrument or candle allowed the line of direction to be found and maintained constant during the experiment. The candle was allowed to burn until the projecting wick dropped its light ash away from the candle, when its burning was constant.

Dr. Hayes alluded to the fact, that the color afforded by the two beams of light was different; and this was apparent on the page, that from the gas light being nearly white, while a brown tint was given to the page by the flame of the candle. He stated that, as the light of flames is due to the ignition of solid matter, the illuminating power of any combustible cannot be inferred from its chemical composition, and although, as a general rule, those gases or vapors which deposit solid, finely divided matter by heat are found to be the best for illumination, yet the introduction of finely divided solid matter into flames composed of hydrogen or atmospheric air will produce luminous effects with the same variations in color.

In observing the page, as illuminated by the two rectangles of light, the eye soon accustoms itself to judging of the sharpness of the outline of the letters, irrespective of the color of the paper, and by retiring backward slightly, the vanishing of the letters on either side is distinctly marked, and the candle can be adjusted to produce equality. The distance of the gas light from the centre of one mirror being constant, the ratio of the light is learned by dividing the square of the gas distance by the square of the candle distance.

The illuminating power of the gas burned in this city had been the subject of his experiments, from which he obtained the result, that (for the last nine months) the light from one burner is equal to that of about twenty candles. The best solid material for illumination is the sperm candle; the illuminating powers of wax and sperm candles are as twelve to sixteen.

Professor Gray read the following communication on the age of a large California Coniferous tree.

"The age attained by the largest known trees is a matter of considerable interest; but it is seldom that an opportunity occurs of testing it by an actual counting of the annual layers of the trunk. This is said to have been done in the case of the gigantic tree recently felled near the head of the Stanislaus River, on the Sierra Nevada, California, a section of the trunk of which, at twenty-five feet from the ground and hollowed out to a shell, is now on exhibition at Philadelphia. The trunk of this tree 'was sound from the sap-wood to the centre'; and its annual layers are very distinct to the naked eye in pieces of the wood in my possession. The size of this tree is such as to give it a presumptive claim to rank among the oldest of the present inhabitants of the earth; its length being 322 feet; the diameter of the trunk, at 5 feet from the ground, 29 feet 2 inches,

at 18 " " 14 " 6 "
at 200 " " 5 " 5 "

including the bark. These measurements are copied from Mr. Lobb's account of the tree, published in England, except the height (by Lobb said to be about three hundred feet), which I have given on the authority of the proprietor of the section now at Philadelphia. This section was taken at the height of twenty-five feet from the ground, and, according to the measurement of my friend, Thomas P. James, Esq. of Philadelphia, it is about twelve feet and a half in diameter, including the bark. Mr. James, at my request, has taken careful measurements of the wood itself, excluding the bark. The three diameters taken by him respectively measure 9 feet 6 inches, 10 feet 4 inches, and 10 feet 10½ inches: the average diameter of the trunk at the height of twenty-five feet from the ground is a little over 10 feet 3 inches. From the statements which have appeared, it would seem as if the layers had actually been counted, and ascertained to be 3,000 in number. This surely ought to have been done; but an examination of the statements does not prove that it was. Mr. Lobb's statement, as definite and reliable as any, is, that 'the trunk of the tree in question was perfectly solid, from the sap-wood to the centre; and, *judging* from the number of concentric rings, its age has been *estimated* at 3,000 years.'

"The number of layers, therefore, has only been *estimated;* and we are not in possession of the exact data on which the estimate was founded. The data wanting are the average thickness of the layers towards the centre, giving the rate of the tree's growth as a young and middle-aged tree, when it must undoubtedly, like other trees, have increased more rapidly than in later years.

"Dr. Lindley, I find, (in the Gardener's Chronicle,) has accredited the estimate which assigns to this tree an age of above 3,000 years; stating that 'it may very well be true, if it does not grow above two inches in diameter in twenty years, which I believe to be the fact.' That rate would indeed give 3,500 layers at the height of five feet from the ground, where it is 29 feet 2 inches in diameter. But this measurement appears to include the bark, — to allow for which Dr. Lindley would perhaps give up the odd 500 years. There is a further consideration. At twenty-five feet from the ground the diameter of the wood is nearly 10 feet 4 inches. Here the rate of two inches in diameter in twenty years would give the trunk an age of only 1,230 years, so that, on these data, the tree in its youth would have been 1,770 years in adding twenty feet to its stature! Evidently the base of the trunk is enlarged somewhat in the manner of Taxodium and other allied trees, when old.

"The section of the trunk at Philadelphia has been hollowed out, by fire and other means, to a shell of 3 or 4½ inches in thickness. Of this I have, through the kindness of the proprietor and of Mr. James, a piece of the wood, including nearly three inches of this section. What is now wanted, and what unfortunately I do not possess, is a foot or two of the wood from the central parts of the tree, — a desideratum which may doubtless be supplied hereafter. The data at hand, however, will suffice for determining an age which the tree cannot exceed, unless it be supposed to have grown more slowly during the earlier nine tenths of its existence than during its later years, — which is directly contrary to the ascertained fact in respect to trees in general. Now the piece of wood in my hands exhibits an average of 48 layers in an inch. The semidiameter of the trunk at the place where it was taken is 5 feet 2 inches. If the tree increased in diameter at the same rate throughout, there would have been 2,976 annual layers; which, allowing 24 years for the tree to have attained the height of 25 feet, would give it an age of 3,000 years from the seed. This corresponds so closely with Dr. Lindley's estimate, that we may suppose him to have employed equivalent data in a similar manner. How great a deduction must we make from this estimate, in consideration of the greater thickness of the layers as a younger tree? The only direct data I possess bearing on this point are derived from a piece of a transverse section, 3½ inches deep, of a 'rail' which the exhibitor says was taken from the trunk at the height of 275 feet from the ground. As its layers, on a breadth of nearly seven eighths of an inch, show only a slight perceptible curvature, it must have come from a part of the trunk still of several feet in diameter. On this section the exterior inch, nearly all alburnum, contains 90 layers; the next, 60; the next, 45; the remaining half-inch, 16, making 32 to the inch. That the exterior layers should be thinner at this height than those near the base of the tree, is just what would be expected. If we apply this ratio of decrease of the number of layers to the inch as we proceed inwards, to the section at twenty-five feet from the ground, we should, at four inches within that part of the circumference which I have examined, have only 17 layers to the inch, which, taken as the average thickness, would make the tree only 1034 + 24 = 1058 years old. But it is not probable that the thickness of the layers increases so rapidly. The data we possess on other trees go to show that a tree, after it is 400 or 500 years old, increases in diameter at a pretty uniform rate for each twenty additional years, on the whole, although the difference in the thickness of any two or more contiguous layers, or of the same layer in different parts of the circumference, is often very great. Still, when we consider how very much thicker are the annual layers of a vigorous young than of an old one, perhaps we should not be warranted in assuming more than the average of 17 layers to the inch for the whole section.

"Some useful data may be obtained from a tree more nearly related than any other to the two California ones, though of a different genus, namely, the so-called Cypress of our Southern States (*Taxodium distichum*). I possess three sections of different trees of Taxodium, reaching from the centre to the circumference. One of these, on an average radius of 27 inches, exhibits 670 layers; a second, on a radius of 30 inches, has 525; a third, on a radius of 22 inches, has 534 layers. The average is 576 layers to a semidiameter of 26 inches, or about 22 layers to an inch. Half of this growth (13 inches radius) was attained at the close of the first century; while the exterior layers of the oldest specimens were only the fiftieth or sixtieth of an inch in thickness. We have reason to believe, therefore, that the *Wellingtonia* (as it is called) of California is at least as rapid in its growth as the Taxodium. We may safely infer, I think, in the absence of other data, that when the tree in question had attained the size of 26 inches in semidiameter, it was only 576 years old. If thereafter we suppose it to have increased at the intermediate rate of 35 layers per inch for the next 26 inches, and at the actual rate of the last century (as ascertained by inspection), namely, at 48 layers per inch, for the remaining 10 inches, we should assign to it the age of 2,066 years as its highest probable age. I think it more likely to be shown, when the wanting data are supplied, that the tree does not antedate the Christian era. There are said to be eighty or ninety such trees, of from ten to twenty feet in diameter, growing within the circuit of a mile from the one felled. When the next of these venerable trees is wantonly destroyed, it is to be hoped that its layers will be accurately counted on the whole section, and the thickness of each century's growth carefully measured on the radius.

" The tree in question is a near relative of the *Redwood* of California, namely, the *Taxodium sempervirens* of Don, of late very properly distinguished as a separate genus under the unmeaning and not euphonious name of *Sequoia*, — a tree now growing in England, and sparingly also in our own vicinity, where it is barely hardy. My friend, Dr. Torrey, has for nearly a year possessed specimens of foliage of this tree, which he took to be a new species of Sequoia. The fruit and branches of the juniper-like foliage (probably only one form of a dimorphous foliage, which is common in *Cupressineæ*) having been received in England from Mr. Lobb by Dr. Lindley and Sir William Hooker, they have recognized in this tree the type of a new genus distinct from Sequoia, to which the former has given the name of *Wellingtonia*. The wood is, I believe, much the same as that of the Redwood, which tree also attains a gigantic size. The principal characters yet ascertained are that the cones of Wellingtonia are oblong, and have a thick woody axis. Additional materials are needed to confirm the genus, if such it be."

Mr. Paine made the following communication on the approaching eclipse of the sun : —

" On the afternoon of Friday, the 26th of May next, there will be an eclipse of the sun visible and generally large throughout the United States, and actually annular in part of the Territories of Washington and Minnesota, of Vancouver's Island, of Canada West, and of the States of Michigan, New York, Vermont, New Hampshire, Maine, and Massachusetts.

" A central, or very nearly central, solar eclipse, at any place, is indeed of rare occurrence. At the city of Paris only one takes place in the 133 years between 1767 and 1900, and although in Boston we have been more favored than Paris, the phenomenon in the century and a quarter between 1775 and 1901, and perhaps many more years, occurs here but four times; namely, in the annular obscurations of April 2, 1791; May 26, 1854; and September 28, 1875; and in that which was total, on June 16, 1806. The eclipse of February 12, 1831, was also annular at Nantucket and at Chatham, Cape Cod, but not elsewhere in New England.

" From computations, the results of which are more particularly given below, it appears that the path of the central eclipse of the 26th of May first enters upon the earth in the North Pacific Ocean near the Caroline Islands, in Lat. of about 6½° North, Long. 197° West; thence taking a northeasterly direction, it touches our continent near Cape Flattery in Washington Territory; it thence passes over Vancouver's Island, British Oregon, Minnesota, Isle Royale, Lake Superior, Canada West, New York, Vermont, New Hampshire, and Maine, to the Atlantic, where it leaves the earth in Lat. of about 36°, Long. 52°, having in $3^{h.}\ 41^{m.}\ 21^{s.}$, the time of its continuance thereon, run over 145½ degrees of longitude and 56 of latitude.

" It, moreover, appears that the duration of the ring, where central, in Washington Territory, is four and a half minutes, (which is nearly its longest duration at any place,) and in New York and New England somewhat less than four, although the ring is about ten seconds broader, and the distance between the lines of the northern and southern limits of the annular phase about thirty miles greater in the northeastern than in the northwestern part of the United States.

" In the Northeastern States, these limits will be well represented by lines drawn on a map, one from the southwestern part of the island of Montreal, over the southern part of the towns of Gardiner and St. George in Maine, to the ocean, and another from Ameliasburg in Canada West, over Ellisburg and Saratoga Springs in New York, Bennington, Vt., Leyden, Sterling, Dedham, Marshfield, and Orleans, in Massachusetts. These lines will be nearly parallel, and distant about 145 English miles, and will include between them the northeastern part of New York, nearly the whole of Vermont, all but the northern part of New Hampshire, the southwestern part of Maine, and, in Massachusetts, the northeastern part of the counties of Franklin, Worcester, Norfolk, Plymouth, and Barnstable, nearly the whole of Middlesex, and the whole of Suffolk and Essex. A third line, drawn nearly equidistant between the two others, from the southern part of Isle Royale in Lake Superior to Ogdensburg, N. Y., thence over Middlebury, Vt., Hanover, Sanbornton, Gilmanton, and Rochester, N. H., to the ocean at Cape Neddock in York, Maine, will represent the path of the *central* eclipse; as a fourth, from Gibraltar Point, near Toronto, C. W., over Delhi and Kingston, N. Y., Middletown, Conn., to Block Island, R. I., will that of the line of eleven digits of obscuration on the north limb of the sun.

"As sixty-three years have passed since the occurrence of the last annular eclipse in New England, and as in the last forty-six years of the present century only one more will take place, it is not doubted that the one of May 26th will be viewed with interest by every spectator; but it is hoped that those observers, within the limits of the ring, who may be provided with a good telescope, will give particular attention to the singular appearances which so often have been noticed at the second and third contacts, and which, in consequence of having been minutely described by the late Mr. Bailly, are known by his name, especially as there is some reason for the suspicion that these beads, &c. may be seen or not, at the pleasure of the observer, according as he employs a screen colored red or green.

"In the eclipse of February 12, 1831, which was viewed by the writer at the light-house on Monomoy Point, off Chatham, with a red screen, these beads were, just before the formation of the ring, so very conspicuous, that it was difficult to determine with precision when it actually took place, whilst in that which was annular in Washington in September, 1838, and that which was total near Savannah in November, 1834, these appearances could not be perceived by him, although carefully looked for through a screen composed of two glasses, one shaded light red, the other light green.

"Indeed, it is particularly desirable that at some places there will be two observers furnished with telescopes of nearly the same optical power, but with screens colored green and red, who, after the second contact, shall exchange their instruments for their observations on the third, and shall note carefully the appearances and phenomena by which each contact is attended.

"The elements of the moon used for the following computations (except the parallax and semidiameter) are the mean of the quantities deduced from the tables of Damoiseau and Burckhardt. Those of the latter were taken from the English and French Nautical Almanacs, but those of Damoiseau were computed for May 26th, 6, 8, 10, and 12 hours of Paris, and thence interpolated for every hour of the meridian of Greenwich. Whilst the difference of the tables in latitude is small, or about a second and a half, in longitude it is very considerable, or eleven seconds. For the parallax, that of Burckhardt was preferred, as corrected by Mr. Adams, one of the distinguished discoverers of the planet Neptune, who, in a memoir affixed to the Nautical Almanac for 1856, appears to have thoroughly investigated the subject.

Path of the Central Eclipse of the Sun over the Earth, Friday, May 26, 1854, according to the Tables of Damoiseau and Burckhardt, for every Fifth Minute whilst crossing the North Pacific Ocean, and for every Minute of the Remainder of the Time of its Continuance on the Earth.

Mean Time at Greenwich.

Mean Time Gr.	Eclipse Central in		Mean Time Gr.	Eclipse Central in	
	Lat. North.	Long. West.		Lat. North.	Long. West.
h. m. s.	° '	° '	h. m. s.	° '	° '
6 54 55	6 38	197 7	8 30 0	41 5	144 40
55 0	7 23	195 22	35 0	42 3	142 54
55 2	7 38	194 34	40 0	42 58	141 4
55 6	7 59	193 46	45 0	43 50	139 11
6 57 30	11 18	187 11	50 0	44 39	137 13
7 0 0	13 11	183 18	55 0	45 26	135 11
5 0	16 12	178 35	*8 55 55	45 34.1	134 47.6
10 0	18 37	174 43	9 0 0	46 10	133 2.9
15 0	20 45	171 40	5 0	46 50	130 50.0
20 0	22 40	169 15	10 0	47 27	128 30.3
25 0	24 26	167 0	15 0	48 0.5	126 3.5
30 0	26 5	164 57	16 0	48 6.7	125 33.4
35 0	27 39	163 2	9 17 0	48 12.8	125 3.0
40 0	29 8	161 14			
45 0	30 33	159 30	*Washington Territory.*		
50 0	31 55	157 50	9 18 0	48 18.7	124 32.3
7 55 0	33 14	156 12	19 0	24.4	124 1.3
8 0 0	34 29	154 35	20 0	30.0	123 30.1
5 0	35 41	152 58	21 0	35.4	122 58.5
10 0	36 51	151 21	22 0	40.6	122 26.6
15 0	37 58	149 44	23 0	45.7	121 54.3
20 0	39 3	148 5	24 0	50.5	121 21.7
8 25 0	40 5	146 24	9 25 0	48 55.2	120 48.9

* On the meridian of the place.

Mean Time Gr.	Eclipse Central in Lat. North.	Eclipse Central in Long. West.
h. m. s.	° ′	° ′
9 26 0	48 59.7	120 15.8
British Oregon.		
9 27 0	49 4.0	119 42.4
28 0	8.1	119 8.6
29 0	12.0	118 34.5
30 0	15.7	118 0.0
31 0	19.2	117 25.1
32 0	22.5	116 49.8
33 0	25.6	116 14.2
34 0	28.5	115 38.2
35 0	31.1	115 1.9
36 0	33.5	114 25.2
37 0	35.7	113 48.2
38 0	37.6	113 10.7
39 0	39.3	112 32.8
40 0	40.8	111 54.6
41 0	42.0	111 16.0
42 0	43.0	110 36.9
43 0	43.7	109 57.4
44 0	44.1	109 17·5
*45 0	44.3	108 37.1
46 0	44.2	107 56.3
47 0	43.8	107 15.0
48 0	43.1	106 33.2
49 0	42.0	105 50.9
50 0	40.6	105 8.1
51 0	39.0	104 24.9
52 0	37.0	103 41.1
53 0	34.7	102 56.8
54 0	32.0	102 11.9
55 0	28.9	101 26.4
56 0	25.5	100 40.4
57 0	21.7	99 53.8
58 0	17.5	99 6.5
9 59 0	12.9	98 18.6
10 0 0	7.9	97 30.1
1 0	49 2.5	96 41.0
2 0	48 56.6	95 51.1
3 0	50.2	95 0.4
10 4 0	48 43.3	94 8.9
N. E. Corner of Minnesota Terr.		
10 5 0	48 35.9	93 16.6
6 0	28.0	92 23.2
7 0	19.5	91 28.8
10 8 0	48 10.4	90 33.5
Isle Royale, Lake Superior.		
10 9 0	48 0.7	89 37.3
Lake Superior.		
10 10 0	47 50.2	88 40.0
11 0	38.9	87 41.4
12 0	27.0	86 41.5
10 13 0	47 14.3	85 40.1
Canada West.		
10 14 0	47 0.9	84 37.2
15 0	46 46.6	83 32.6
16 0	31.3	82 26.3
17 0	46 14.8	81 17.9
18 0	45 57.1	80 7.2
19 0	38.0	78 53.9
20 0	45 17.5	77 37.6
21 0	44 55.3	76 17.8
21 15	49.5	75 57.2
10 21 30	44 43.5	75 36.4
State of New York.		
10 21 45	44 37.4	75 15.3
22 0	31.2	74 53.9
22 15	24.8	74 32.3
22 30	18.3	74 10.3
10 22 45	44 11.6	73 48.0
Lake Champlain.		
10 23 0	44 4.8	73 25.4
State of Vermont.		
10 23 15	43 57.8	73 2.4
23 30	50.6	72 39.0
10 23 45	43 43.3	72 15.3
State of New Hampshire.		
10 24 0	43 35.7	71 51.2
24 15	27.9	71 26.7
10 24 30	43 19.9	71 1.8
State of Maine.		
10 24 45	43 11.6	70 36.2
Atlantic Ocean.		
10 25 0	43 3.2	70 10.1

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* Greatest north latitude of the central path.

Mean Time Gr.	Eclipse Central in Lat. North.	 Long. West.	Mean Time Gr.	Eclipse Central in Lat. North.	 Long. West.
h. m. s.	° ′	° ′	h. m. s.	° ′	° ′
10 26 0	42 26.4	68 18.2	10 30 0	37 54.2	55 58.6
27 0	41 43.7	66 13.9	30 12	37 5.7	53 56.7
28 0	40 52.4	63 48.9	30 15	36 41.8	52 57.3
10 29 0	39 45.4	60 47.5	10 30 16.1	36 17.4	51 56.8

Duration of the central eclipse on the earth, $3^{\mathrm{h.}}\ 41^{\mathrm{m.}}\ 21^{\mathrm{s.}}.1$.

According to the Tables of Damoiseau and Burckhardt, the eclipse at the following places will be *annular*, and take place as follows, in mean time of the respective places : —

	Boston.	Brunswick, Me.	Cambridge Obs.
	° ′ ″	° ′	° ′ ″
Latitude,	42 21 23	43 53	42 22 48
Longitude,	71 3 37	69 55	71 7 30
	h. m. s.	h. m. s.	h. m. s.
Eclipse begins,	4 27 12	4 30 47	4 26 52.5
Formation of the Ring,	5 40 28	5 43 10	5 40 8.6
Least distance of centres,	41 27	44 21	41 8.8
Rupture of the Ring,	5 42 27	5 45 32	5 42 9.1
End of the Eclipse,	6 47 33	6 50 8	6 47 16.0
Duration of the Ring,	1 59	2 22	2 0.5
“ “ Eclipse,	2 20 21	2 19 21	2 20 23.5
	″	″	″
At least of north limbs,	7.25	92.66	7.37
distance. of centres,	44.43	40.94	44.30
Distance of south limbs,	96.11	10.78	95.98
	°	°	°
Point of beginning,	150.5	151.5	150.5
“ end,	34.0	38.1	34.0

	Concord, N. H.	Hanover, N. H.	Middlebury, Vt.
	° ′ ″	° ′ ″	° ′
Latitude,	43 12 30	43 42 26	44 0
Longitude,	71 29	72 16 45	73 10
	h. m. s.	h. m. s.	h. m. s.
Eclipse begins,	4 24 8	4 19 42.4	4 15 3
Formation of the Ring,	5 36 43	5 32 41.0	5 28 32
Least distance of centres,	38 38	34 38.6	30 30
Rupture of the Ring,	5 40 32	5 36 36.2	5 32 28
End of the Eclipse,	6 45 0	6 41 25.4	6 37 42
Duration of the Ring,	3 49	3 55.2	3 56
“ “ Eclipse,	2 20 52	2 21 43.0	2 22 39
	″	″	″
At least of north limbs,	39.61	50.66	51.33
distance. of centres,	11.91	0.66	0.19
Distance of south limbs,	63.43	51.98	50.99
	°	°	°
Point of beginning,	150.8	150.7	150.5
“ end,	35.5	36.0	35.9

	Ogdensburg, N. Y.	Portsmouth, N. H.	Scarboro' Harbor.
	° ′ ″	° ′ ″	° ′ ″
Latitude,	44 42 0	43 4 35	48 21 49
Longitude,	75 31 30	70 45 18	124 37 12
	h. m. s.	h. m. s.	h. m. s.
Eclipse begins,	4 2 40	4 27 47	11 22 52
Formation of the Ring,	5 17 29	5 39 55	0 57 11
Least distance of centres,	19 28	41 52	0 59 26
Rupture of the Ring,	5 21 26	5 43 47	1 1 40
End of the Eclipse,	6 27 46	6 47 54	2 33 41
Duration of the Ring,	3 57	3 52	4 29
" " Eclipse,	2 25 6	2 20 7	3 10 49
	″	″	″
At least of north limbs,	50.80	44.32	46.48
distance. of centres,	0.16	7.35	3.37
Distance of south limbs,	50.48	59.02	39.74
	°	°	°
Point of beginning,	149.9	150.9	101.4
" end,	35.6	35.1	32.0

At the following places the eclipse will not be annular. The obscuration at Halifax, N. S., Charlottetown, P. E. I., and Montreal, being on the southern side of the sun, and at the other places on the northern.

	Charlottetown, P. E. Island.	Georgetown Obs., D. C.	Halifax, Nova Scotia.	Middletown Obs., Conn.
	° ′	° ′ ″	° ′ ″	° ′ ″
Latitude North,	46 14	38 54 26	44 39 20	41 33 8
Longitude West,	63 8	77 4 33	63 26 8	72 38 30
	h. m. s.	h. m. s.	h. m. s.	h. m. s.
Eclipse begins,	4 59 31	4 2 33.2	4 59 52.8	4 20 39.6
Greatest obscuration,	6 9 4	5 19 45.2	6 9 47.9	5 35 43.9
End of Eclipse,	7 12 6	6 27 28.8	7 12 59.0	6 42 21.4
Duration,	2 12 35	2 24 55.6	2 13 6.2	2 21 41.8
	°	°	°	°
Point of beginning,	154.5	147.1	153.7	149.6
" end,	48.1	21.8	44.8	31.1
Digits eclipsed,	10.147	9.814	10.594	11.013

	Nantucket Obs., Mass.	New York C. H., N. Y.	Philadelphia Observatory.	Portland, Oregon.
	° ′ ″	° ′ ″	° ′ ″	° ′
Latitude North,	41 16 56	40 42 40	39 57 9	45 30.1
Longitude West,	70 5 40	74 0 30	75 10 0	122 27.5
	h. m. s.	h. m. s.	h. m. s.	h. m. s.
Eclipse begins,	4 33 8.8	4 15 8.9	4 10 31.8	11 31 59
Greatest obscuration,	5 46 46.0	5 30 55.8	5 26 48.8	1 11 10
End of Eclipse,	6 52 16.4	6 37 55.1	6 34 6.9	2 46 57
Duration,	2 19 7.6	2 22 46.2	2 23 35.1	3 14 58
	°	°	°	°
Point of beginning,	150.3	148.9	148.2	97.9
" end,	32.6	28.2	25.6	22.0
Digits eclipsed,	11.173	10.640	10.306	10.675

	Providence Obs., R. I.	San Francisco, California.	Toronto Obs., Canada West.	Williamstown Obs., Mass.
	° ′ ″	° ′ ″	° ′ ″	° ′ ″
Latitude North,	41 49 32	37 47 36	43 39 24	42 42 49
Longitude West,	71 24 15	122 26 48	79 21 30	73 12 37
	h. m. s.	h. m. s.	h. m. s.	h. m. s.
Eclipse begins,	4 26 14.6	11 25 3	3 44 40.6	4 16 26.0
Greatest obscuration,	5 40 38.6	1 3 59	5 3 50.0	5 31 54.5
End of Eclipse,	6 46 47.1	2 45 55	6 13 50.4	6 38 58.2
Duration,	2 20 32.5	3 20 52	2 29 9.8	2 22 32.2
	°	°	°	°
Point of beginning,	150.2	76.2	148.3	150.0
" end,	32.7	2.8	30.6	33.2
Digits eclipsed,	11.207	8.123	11.059	11.301

At *Eastham* Church, Cape Cod, Mass., in Lat. 41° 50′ 26″, Long. 69° 58′ 40″, the least distance of the centres (51″.81) will take place at $5^{h.}$ $46^{m.}$ $31^{s.}$; diff. of semidiameters 51″.94; from which it appears that the line of the southern limit of the ring passes on to the Atlantic about two miles south of Nausett lights, or in Lat. 41° 49′ 37″, Long. 69° 56′ 50″.

At *Montreal*, Canada, Lat. 45° 31′, Long. 73° 35′, the least distance, 62″.3, will be at $5^{h.}$ $26^{m.}$ $40^{s.}$; and as the difference of the semidiameters will be 51″.5 only, the eclipse will not be annular there, but probably will be so in the southwestern extremity of Montreal Island.

The village of Saratoga Springs, N. Y., Lat. 43° 3′, Long. 73° 43′, appears to be situated exactly under the line of the southern limit of the ring, as the least distance of the centres (51″.2), which occurs at $5^{h.}$ $29^{m.}$.3, is, according to the tables, the same as the difference of the semidiameters.

The difference between the *absolute* or Greenwich times of the beginning at Georgetown, New York, Boston, Brunswick, Charlottetown, &c., is quite small, or less than two minutes, or from $9^{h.}$ $10^{m.}$ $27^{s.}$ to $9^{h.}$ $12^{m.}$ $3^{s.}$ The time at any other place between them, and near the Atlantic, may therefore be easily ascertained with a good degree of accuracy, and without a direct computation, by subtracting its longitude from about $9^{h.}$ $11^{m.}$, and in this manner the time of the beginning at the following cities and towns was ascertained. The angle of the point at which the first impression will be made on the sun, or at which the eclipse will commence, is reckoned from the vertex to the right hand, and that at which the obscuration will end, from the vertex to the left (except at San Francisco, where it is also to the right), as seen through an *erect* telescope. For one that inverts, it is necessary to add 180°.

At those places marked with an asterisk, the eclipse will be annular.

Place.	Eclipse begins. P. M.	Angle from Vertex.	Place.	Eclipse begins. P. M.	Angle from Vertex.
	h. m.	°		h. m.	°
Albany, N. Y.,	4 14.0	150	N. Bedford, Mass.,	4 28.6	150
Amherst, Mass.,	4 20.2	150	*Newburyp't, Ms.,	4 27.5	151
*Andover, Mass.,	4 26.4	151	N. Haven, Conn.,	4 19.5	149
Annapolis, Md.,	4 5.0	148	Newport, R. I.,	4 27.0	150
Baltimore, Md.,	4 4.5	147	Norwich, Conn.,	4 23.5	150
Bangor, Me.,	4 36.0	153	*Plattsburg, N.Y.,	4 12.2	150
Burlington, N. J.,	4 11.7	148	Plymouth, Mass.,	4 29.3	150
*Burlington, Vt.,	4 14.3	151	*Portland, Me.,	4 29.7	151
*Dover, N. H.,	4 27.1	151	Princeton, N. J.,	4 12.5	148
Eastport, Me.,	4 43.5	153	*Provincetown,Ms.,	4 31.5	151
*Exeter, N. H.,	4 27.0	151	*Salem, Mass.,	4 27.6	151
*Gloucester, Mass.,	4 28.0	151	Springfield, Mass.,	4 20.5	150
*Lowell, Mass.,	4 25.5	151	Trenton, N. J.,	4 12.1	148
Montreal, C. E.,	4 11.3	151	West Point, N. Y.,	4 14.6	149
Newark, N. J.,	4 14.5	149	Worcester, Mass.,	4 24.1	150

Elements of the Eclipse. Mean Time at Greenwich.

Hour.	⊙'s Longitude.	⊙'s Lat.	⊙'s Right Asc.	Declination.	Semidiam.	Sid. Time.
	° ′ ″	″	° ′ ″	° ′ ″	′ ″	h. m. s.
5	65 3 26.60	N.0.05	63 6 54.62	21 9 35.18	15 48.91	4 15 44.14
6	5 50.55	.06	9 26.47	10 1.08	48.90	15 54.00
7	8 14.50	.06	11 58.32	10 26.94	48.89	16 3.86
8	10 38.45	.07	14 30.19	10 52.77	48.89	16 13.71
9	13 2.40	.08	17 2.07	11 18.56	48.88	16 23.57
10	15 26.35	.08	19 33.97	11 44.31	48.87	16 33.43
11	17 50.30	.09	22 5.87	12 10.02	48.87	16 43.28
12	65 20 14.24	N.0.09	63 24 37.79	21 12 35.69	15 48.86	4 16 53.14

⊙'s Horizontal Parallax, 8″.46 ; Obliquity, 23° 27′ 34″.1 ; Ellipticity, $\frac{1}{300}$th.

Lunar Elements by Burckhardt and Damoiseau.

Hour.	Moon's Longitude.		B. greater, D. less, by	Moon's Latitude North.		B. greater, D. less, by	Adams's Moon's Eq. Par.	Adams's Semidiameter.
	° ′ ″	′ ″	″	′ ″	′ ″	″	′ ″	′ ″
5	63 18 22.31	30 9.36	5.36	10 56.34	2 47.37	0.82	54 34.94	14 54.16
6	63 48 31.67	30 8.49	5.34	13 43.71	2 47.19	0.73	34.17	53.95
7	64 18 40.16	30 7.63	5.36	16 30.90	2 47.00	0.67	33.41	53.74
8	64 48 47.79	30 6.79	5.43	19 17.90	2 46.82	0.63	32.66	53.54
9	65 18 54.58	30 5.98	5.51	22 4.72	2 46.64	0.62	31.91	53.33
10	65 49 0.56	30 5.21	5.60	24 51.36	2 46.44	0.63	31.16	53.13
11	66 19 5.77	30 4.45	5.67	27 37.80	2 46.25	0.62	30.43	52.93
12	66 49 10.22		5.70	30 24.05		0.59	54 29.70	14 52.73

Hour.	Moon's Right Ascension.		Moon's Declination.		Damoiseau's	
					Moon's Eq. Par.	Semidiameter.
	° ′ ″	′ ″	° ′ ″	′ ″	′ ″	′ ″
5	61 14 5.22	31 9.53	21 0 48.77	8 28.01	54 33.58	14 52.49
6	61 45 14.75	31 12.26	9 16.78	8 22.06	32.82	52.28
7	62 16 27.01	31 14.98	17 38.84	8 16.06	32.07	52.07
8	62 47 41.99	31 17.62	25 54.90	8 10.01	31.32	51.87
9	63 18 59.61	31 20.32	34 4.91	8 3.92	30.58	51.67
10	63 50 19.93	31 23.01	42 8.83	7 57.81	29.86	51.47
11	64 21 42.94	31 25.68	50 6.64	7 51.67	29.16	51.28
12	64 53 8.62		21 57 58.31		54 28.51	14 51.10

Three hundred and ninety-seventh meeting.

March 28, 1854. — Semi-Monthly Meeting.

The Vice-President, and afterwards the President, in the chair.

The Corresponding Secretary read a letter from the Trustees of the Astor Library, acknowledging the reception of Vol. V. Part I. of the Academy's Memoirs, and Vols. II. and III. (as far as published) of the Proceedings; also a letter from Rev. Charles Brooks on the Weather Law.

Professor Lovering exhibited a bioscope; an optical instrument for giving the motions of life to pictures, and illustrating the great advancement of optical science. This instrument combines the three important modern discoveries of the daguerreotype, the stereoscope, and the phenakistiscope. The daguerreotype gives a perfect picture, without solidity or motion; the stereoscope suggests the idea of solidity without motion; the phenakistiscope imparts life by motion. The bioscope obtains perfect figures from the daguerreotype. By a stereoscopic arrangement of mirrors adapted to both eyes, the figures acquire solidity; and by the revolution of the phenakistiscope, the figures exhibit the motions of life. It requires some practice to see all that the instrument is capable of showing; and the combination admits of considerable improvement.

Professor W. B. Rogers made a communication on the natural coke found in the vicinity of Richmond, Virginia. This